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Studies of Insects Associated with the American Mistletoe.

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INTRODUCTION.

By the name "American mistletoe" the species *Phoradendron flavescens* Nuttall is meant, and of this peculiar aboreal shrub several varieties are described by botanists. The plant thrives most exuberantly throughout the South and the Pacific coast region of the United States. On account of its near relationship to the renowned European mistletoe or "Wood of the Holy Cross," *Viscum album* L., the American countertype has inherited the popular traditional attributes of that symbol of veneration. Its use for festival adornments at Christmastide has consequently earned for it the standing of a marketable product during this season of celebration.

But little repute is now accorded it for medicinal virtues. While it is not considered to possess any special merit for healing properties, yet in winter when succulent herbs are scarce or lacking it affords a substitution which country folks often resort to, and thus utilize the shoots in order to make a vegetable lotion for the remedial treatment of scalds or wounds. The desired extract is prepared by boiling the leaves and stems together in water. In its green state it is also esteemed as a food tonic for live stock, especially cows and mares directly after one or the other has given birth, as the case may be, either to a calf or a colt. Such usages, however, are not thought to be in common vogue outside of certain sectional bounds.

Owing to its parasitic nature in growing upon live timber, it has come to be regarded in some localities of Texas, Louisiana, Mississippi and Tennessee as a serious detriment to the perfection and vitality of shade trees in particular. The results of investigations of its injuries to such growth, embracing an account of its life history and the practical methods for its suppression, have been published under the title of "The Mistletoe Pest in the Southwest," by Prof. W. L. Bray.[1]

Not much contemplation has heretofore been devoted to the insects which normally inhabit or otherwise visit any of the various mistletoes. Of most importance in respect to the advances that have been achieved in this direction, aside from the incidental contributions by Prof. T. D. A. Cockerell in dealing with the Coccidæ, is the pertinent treatise by Mr. E. A. Schwarz.[2] The study of mistletoe insects is not only interesting for the sake of the romantic fame of the floral stock itself, but it offers unquestionable possibilities for new scientific revelations. Even though the pursuit has from time to time in the past led to the detection of valid species of Hexapoda which had formerly been unknown, the range of endeavor is by no means fully covered. Taking the substance of the present report into consideration, the progress so far attained in the quest has reached the point where it now tenders a basic list of the attendant fauna and a fair knowledge of the habits of the latter in conjunction. That the American mistletoe should be invested with a singular but yet potent aptitude as a host plant from an entomological standpoint first came to the writer's notice by accident. This matter primarily appertained to a rare weevil concerning which the following details of inquiry have been recorded.

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[1] U. S. Dept. Agric., Bu. Plant Ind., Bul. 166; 1910.

[2] See Bibliography for each author.

THE WINTER MISTLETOE WEEVIL.

(*Smicraulax tuberculatus* Pierce.)

While making a short trip into the country near Plano, Tex., on December 12, 1908, the writer took advantage of an opportunity to obtain some mistletoe for Christmas decorations. Accordingly, after collecting several bunches of *Phoradendron flavescens* from hackberry trees, the pick of them was carried to Dallas and hung around the rooms of the house then occupied as living quarters. About ten days later, on being seated at dinner, attention happened to be drawn to a small weevil crawling on the tablecloth. Its strange presence excited surprise, and it was therefore immediately captured for closer scrutiny. Within a few more days the appearance of a tiny winged wasp in a similar manner again caused wonderment as to the source of this suspectedly hostile interloper, and correspondingly revived the problem bearing on the obtrusion of the former visitant. In pondering over the circumstances in search of a clue, the idea was suddenly conceived that both of the bodies had dropped down from some sprigs of mistletoe which festooned an electric chandelier, this fixture being suspended from the ceiling right above the table.

Suspicion was thus directed to the plants as having harbored these guests. At this time the branches had become much dried and shriveled, and, moreover, since Christmas day had passed for the year, they conferred no further commemorative attraction. All of them were promptly removed and placed in a breeding box belonging in an outdoor insectary. They forthwith furnished proof of infestation by producing different parasitic imagoes at intervals during the subsequent month of January, 1909, although no additional weevil emerged.

By reason of its odd figure and intimation of having bred in the mistletoe, the weevil already in hand was expeditiously forwarded to Mr. W. D. Pierce, in Washington, D. C., for identification. He reported that it was the second cognitive example of his genus and species, *Smicraulax tuberculatus,* just previously defined in his paper, "Descriptions of New Curculionid Beetles of the Tribe Anthonomini."[3] Nothing more then chanced to be learned about it than that "the type specimen was collected by Mr. E. A. Schwarz on black persimmon," at San Diego, Tex. Mr. Pierce urged that observations regarding it be followed up.

In the acquisition of parasites the first subject, which was caught by luck, agreed with authentically named representatives of *Catolaccus incertus* Ashm. Likewise, by comparison, the others appearing in January proved to be a female *Cerambycobius cyaniceps* Ashm., a male and a female *Eurytoma tylodermatis* Ashm., and a male *Bracon mellitor* Say. Furthermore, two dead males of *Catolaccus hunteri* Cwfd. were taken on March 12 at the final inspection of the material. Since all of these agents were known to attack the immature stages of the cotton boll weevil, *Anthonomus grandis* Boh., their possible connection with *Smicraulax tuberculatus* Pierce introduced an astonishing exigent phase, in which the latter seemed to fill a very important position as winter cohost for the parasites.

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[3] Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 173, 174.

Such relations in fact were shortly established by conclusive evidence. Their disclosure consequently extended the scope of an investigation then being centered upon the parasitical control of the boll weevil. Previous to this discovery not very many native Rhynchophora which foster the parasites that also prey upon the boll weevil had been found to breed with any degree of activity through winter. In the present case the hiemal concurrence of the development of *Smicraulax tuberculatus* with the vigorous growing and fruiting term of the host plant placed the tenant in the rather unique rôle of an intermediary capable of sustaining several kinds of parasites through a crucial period of the year. Under other conditions generally prevailing these salvagers instinctively enter into hibernation on the approach of cold weather and pass the winter in torpid inanimation. Moreover, as *Smicraulax tuberculatus* is structurally allied to the cotton pest, it should be expected quite naturally to attract parasites that evince a preference for members of the tribe Anthonomini.

During another trip to Plano, on February 12, 1909, a second supply of *Phoradendron flavescens* was secured from like trees in the same vicinity where the first collection had been made in the preceding December. These branches uniformly answered to the varietal name of *villosum* Eng., this discrimination being ascertained next day by reference to botanical literature. Then, on slitting open some of the joints, a number of diminutive larvæ exhibiting all the characteristics of a weevil grub were exposed to view, mainly within the terminal stems. They were concordantly judged to be the young of the eagerly sought weevil. With the removal of eight subjects for preservation, three dead ones were included. The mortality among them was believed to have been due to a hard freeze brought on by a recent spell of low temperatures.

Most of the infested sprigs had an unhealthy look. On one branch all the leaves had turned brown. No swelling, however, appeared on any part that had suffered impairment. These stems seldom measured less than 2 mm. in diameter, but occasionally the work of a grub was noted in twigs nearly 5 mm. thick. At divers places on the bark a slight nick showed where an incision had obviously been effected, either for oviposition or food alone. From the majority of these dints a thin discolored streak was traced diagonally into the heart of the stem. Here a single larva was commonly descried inside of a gallery or cell. In many instances the separate burrows ran almost through the entire length of a scanty joint, but ordinarily they were much shorter, sometimes being nothing more than a mere hollow space. Where an exit hole had been cut out from a tunnel, the perforation usually opened on or was close to a nodular dilation.

The body color of the larvæ was perceived to impart a faint yellowish tint to the skin, but the pallor set off the brown head shield and black mouth parts in strong contrast. Those selections of the progeny that seemed to be full grown had a linear extension of about 2 mm. One male chalcidoid, so far remaining undetermined, issued on March 24 from the shoots which were held in reserve, but no complemental realization attended this breeding test.

Mr. Pierce himself joined the writer on an excursion for the third lot of mistletoe. These plants were picked from oak trees, *Quercus schneckii* Britt., near Dallas, Tex., on March 6. This stock yielded the positive results which fully confirmed our assumptions regarding the generative activities and influential sphere of *Smicraulax tuberculatus,* and besides pointed out the association of another weevil, *Pandeleteius cinereus* Horn. Notes on the latter species and also the other kinds of insects that were collected in the prosecution of this and the succeeding explorations, taking the enemies as acquired with their hosts, are presented farther ahead in systematic order.

Needless to say almost, the substantial returns as derived from this accession were very gratifying. Those features that applied to the main proposition now in hand were brought out by the following ascertainments. A teneral adult of *Smicraulax tuberculatus,* the first exemplar of its sort that happened to be espied *in situ,* was abstracted from its tiny den in a twig and saved for later mounting. The betraying scars on the surface of the woody growth as well as the inner cavities were more frequently located at intermediate distances along the stems than near their junctures. Many of the excavations had already been vacated, yet the freshly bored outlets denoted that the originative inmates had but lately gained their freedom. Nevertheless, a proportion of the brood lingered behind. One joint alone still retained not only a larva, but also a pupa. Though a solid partition had separated them, both were parasitized alike. This proximity of the two stages comprised the sole exception wherein more than a single form of the weevil were found to occupy an identical section of any offshoot. The sickly yellow tinge of this piece testified to the severity of the internal depredations.

Although the tentative diagnosis was limited to just a few sample branches, this appraisement, however, took twenty-two exemplifications of the weevil into account. The conditional findings in these respects are summarized herewith:

Stages alive, unaffected	6	= 5 larvæ and 1 teneral adult.
Stages alive, parasitized	8	= 7 larvæ and 1 pupa.
Stages dead, due to parasites	2	= 2 larvæ (1 with grub and 1 with pupa of *Catolaccus sp.*)
Stages dead, charged to cold	6	= 6 larvæ.

For parasitism the inhibitive rating was 45.4 per cent; for fatality attributed to cold, 27.3 per cent. These factors, therefore, gave a total mortality of 72.7 per cent, prospectively involving the doom of the eight forms still withstanding the grasps of their deadly foes.

Four of the inimical dependents matured in isolation, producing a male and a female chalcidoid on March 30 and likewise another pair on April 3. Their specific identities have not yet been conclusively determined, but a couple of them were justifiably referred to the genus *Catolaccus* on the strength of their formative distinctions. From the bulk of the sprigs that had been kept under watch two collateral members of the same class perfected their emergencies on April 2, and again five others, consisting of three males and two females, were secured on April 6. The cages also contained three adult weevils on the latter date, and solitary individuals were afterwards entrapped on April 19 and 29, and lastly on May 3.

Even with these few specimens, the outcome was especially appreciated for the reason that it gave tangible results, notwithstanding the handicaps which attended the test. The drying and shriveling of the branches shortly after they had been stored away, despite their placement on a bed of moist sand, plainly imposed a check upon the progress of the indwelling forms to a large extent, and thus curtailed their ultimate attainments.

At the next trial an attempt was made to overcome the latter difficulty by inclosing the fresh plants in a tight receptacle that conserved the moisture, but this procedure soon had to be abandoned owing to the formation of mold on the stems and leaves. This new supply of shoots was gathered on April 7 from the same oak trees as before. Two live weevils, the only free ones ever bagged on a visit to the field in person, were, by good fortune, sifted out from the mass of twigs and litter prior to the transference of the suitable portions into the repository.

As in the other cases, a part of the material was first sectioned in order to ascertain if the degree of infection would warrant the consignment of the greater quantity. On arriving at a favorable decision to this effect, the remaining stock was then utilized for the experiment. At its termination these pieces were also slit into bits and carefully inspected. In consequence the dissections at the start, together with those at the finish, brought to light four extra imagoes reposing in as many joints. Two of these examples, however, failed to manifest any animation, yet, queerly enough, one was lodged headforemost within the orifice at the outer end of its passage that had been made ready for its egress. The cause of its death on the verge of release could not be solved. Of the thirteen larvæ which were scatteringly located all proved to be dead, although only two of them had been assailed by parasites.

Quite a number of empty chambers were laid open in the same manner, and these decisively attested to an early liberation of adults in nature. Owing to the fact that nearly every mine had been driven full against or even into a junctional knob, this phase set them off at a variance with the precedent definements in regard to construction. Escape therefrom was necessarily achieved through a transverse penetration leading from the main recess to the exterior, thereby forming the outlet which has been alluded to before. As might be presumed, this aperature was drilled to the circumferential size of a mature weevil, and as well marked the region of the destructive operations of the insect when in the larval stage. In reality the two borings usually conjoined at a point close to the terminal limits of the inner one, and thus abutted upon a node in nearly equal juxtaposition.

The late punctures in the bark were found to have been inflicted rather indiscriminately on diverse sides of the stems. Altogether sixty-four resultant scars were counted, each flaw being barely distinguished by its indenture. Still, on parting their tissues, no egg could be discerned in any of the lesions. Those pits in which the deposition of ova and the sequential hatching of the latter had been consummated beyond all question of doubt were readily differentiated from the others whose perpetrations implicated no further design than that of feeding by the parent weevils. As a matter of fact, the distinctive sign of embryonic culmination consisted of a morbid discolorment of the woody fibers beneath the cleft in the integument wherever the event had taken place. From this blotch a tenuous stain receded slantwise in a longitudinal prolongation through the grain until it reached the heart. Here it often connected with a larval breach. Such tracings clearly demarcated the course which a newly hatched grub had pursued in forcing a way for itself from its birthplace into the core of the stem.

The next advisable step for carrying on the project was to acquire information relative to the distribution of *Smicraulax tuberculatus.* This desideratum accordingly became an incentive for a broad survey. Some cursory scouting had already been done in two localities along the lower Red river in Louisiana, first by the writer while on a trip to Alexandria during February 27, and thence to Mansura on March 2 (of the same year, 1909). The outcome of these visits in person, however, fell short of rendering any positive interpretation, because of the failure to find a weevil or definite sign of one. Even with the closest scrutation, nothing was seen to occasion much concern except in respect to the plants at Alexandria. On the bark of their branches a few slight notches chanced to be perceived whose semblance to shrunken punctures was strongly suggestive of mischief. If these defects conveyed any entomological significance, such could only be surmised with reference to *Pandeleteius* sp., the larvæ of which were taken from mistletoe at Mansura by Mr. W. D. Pierce hardly more than six weeks later, or on April 13, when he fulfilled an engagement there himself. His record is the only one so far obtained which authenticates the existence of any mistletoe weevil in the state of Louisiana, and the full particulars are cited in their proper place among the various notes on *Pandeleteius cinereus.*

Yet on April 10, during a stop at Natchez, Miss., Mr. Pierce had found larvæ which he thought belonged to his new species. But owing to other demands, his examination was limited to just a few sprigs of mistletoe that had grown on live oak. He also reported that a young chalcidoid parasite was attached to one of the grubs. The writer's subsequent assignment on official duty near the same city allowed opportunities for making some personal observations on the occurrence of the insect in that locality.

At the start of operations, on May 22, an ample quantity of *Phoradendron flavescens* was detached from an elm tree. Assurances of a late intrenchment by *Smicraulax tuberculatus* were warranted at once upon sight of its ovipositional imprints and channels of escape, these being displayed in profusion. Hence by disseverment of the stems plenty of cells were scanned within them. Since they mainly lacked occupants, no live stages were run onto, although eight larval bodies happened to be uncovered, three of which had succumbed to parasitism. The deaths of the remainder had likely been induced by the heat of summer and the reparative tendencies of the plant itself, as was inferred after studying the supplemental acquisitions. Attempts to rear the parasites failed absolutely, and neither did the supervening trials that were instituted in like cases avail to any purpose.

While the branches showed that they had been highly infested earlier in the season, yet at this time they gave no proof of any propagative continuity on the part of the marauder. The same conditions applied to all of the inspections of mistletoe that were undertaken up to their close on June 2. Such circumstances supported the belief that the ascendence of warm temperatures conduced to bring about a suspension of breeding. This opinion was eventually corroborated by inquiries conducted at Dallas again and elsewhere in Texas until along in 1911. Nevertheless, further investigations are required in order to solve the question as to how the weevil survives from spring to fall, and whether it actually resumes the exercise of its reproductive unctions much before December.

The liklihood that it ranges to the east side of the Mississippi river, however, was duly conceded, though this claim needs to be fully substantiated. This admission, moreover, predicates an adaptability of the insect to live wherever its host plant exists.

Another matter of interest that commanded a due share of attention at this time and henceforth related to the manner in which the plants had endeavored to heal up their wounds. Hitherto very little indication of such an aptitude had been revealed, whereas, more especially in the collections at Natchez, Miss., than any of the later ones, a great number of the damaged stems had made marked advances toward recovery. With the object of gaining a fundamental conception of these phases, each lot of mistletoe was promptly examined with particular care. As a result the following adductions were gleaned:

In regard to the areas wherein the borer had operated, most of them were observed to be filled with a resinous gum. The consistency of this product, however, varied from a semiviscid state to one of hard density. Its solidification was obviously attained through age. In every case it was distinguished by its brownish translucence. Owing to its permeation into the surrounding grain, the latter had acquired a concolorous tinge. This substance had therefore practically obliterated the ill effects of the inroads in those places that seemed to have had sufficient time wherewith to accomplish their recuperation.

Since the restorative process through such means was conceived to be analogous to proliferation, the risk of its crushing force upon a feeble attacking larva impressed the mind as being an important factor. In reality, not only at Natchez but in the concluding surveys as well, dead grubs were occasionally found embedded in the deposits. On account of the plastic condition of the content in each of these instances, it then appeared to be but newly secreted. The mummified bodies were always of small size, because the forms had made very little headway in life when foiled. Consequently, no better reason can be given in explanation of their lethality than that the young creatures were overcome by the pressure of the accretions which had first engulfed them. On the other hand, many individuals had apparently been able to forge ahead in spite of these complications, having doubtlessly succeeded in firmly establishing themselves at the outset.

The occlusion of the exit holes was also noted. Such repairments were effected by an outgrowth of the cambium layer over the raw edges, as would naturally be expected. In a number of cases those parts of the sprigs that had undergone the worst inflictions showed a noticeable distention of the sides, the outlines of which conformed to a bulge of more or less linear convergence. These swellings accordingly afforded evidence of a rapid enlargement of the growth for reinforcement of the weakened structure. Otherwise, except for the persistent rays resulting from the entrance of larvæ, the enveloping wood had regained a sound and healthy look.

Henceforth the reconnoissances were continued as opportunity permitted, the prime object being to learn more about *Smicraulax tuberculatus* and its parasites. This intention was also coupled with a proposal to ascertain incidently if the excessive droughts and extremes of summer and winter temperatures that were experienced in Texas during the years of 1909 and 1910, and which exerted a marked constraint upon insect life in general throughout the state, had reacted in any such manner upon the mistletoe raiders. The ultimate conclusions that these years had proven unfavorable by bringing about both a curtailment in the ranks of the weevils and an absence of their kindred enemies were educed from the following memoranda.

At Dallas, Tex., on December 19, 1910, some branches of mistletoe were found to be rather commonly, but by no means extensively, attacked; still on the other hand, a large amount of the plants had not been molested at all. The former had thereby incurred quite a complex of bores. Those of old or recent assuagement, however, outnumbered the fresh commitals. As a rule, the thin stems had suffered most from the onsets. No parasitized larva was taken, and nothing besides two adults of *Smicraulax tuberculatus* issued from the joints. These specimens made their appearance along in February, 1911. Yet in the initial examination a dead imago had been extracted from a cavity wherein it was lying with its head directed forward at the point of egress, thus occupying about the same position as has been mentioned once before. Three additional collections of *Phoradendron flavescens,* these being obtained at weekly intervals during the subsequent month of March, gave utterly negative returns respecting the weevil.

Just enough evidence was secured at Sherman, Tex., on January 10, 1911, to vouch for the scarcity of the species in that locality. Although the operative members had already matured and escaped, leaving their empty burrows and fresh emergence holes in partial attestation, still unquestionable proof of their identity was presented in one cell which contained a pupal exuvia together with the larval headplate, while another space held an entire dead grub. A few scars on the bark and the accompanying stains within the joints completed the chain of incriminations to be preferred against the insect. The fact that very little mistletoe was seen growing in the country provoked some perplexity.

The signs of greatest activity by *Smicraulax tuberculatus* came to notice after the approach of settled spring weather. They occurred on two bunches of mistletoe which were hastily snatched from a hackberry tree near Mesquite, Tex., on April 27, but a dead larva comprised the only stage that remained in the shoots. Since further search was prevented owing to the limitation of time then devoted to a special mission, these branches may not have tendered a true indication of general prevalence by the adversary. This record constituted the last of the series.

Besides *Smicraulax tuberculatus,* two other species of weevils are known to breed in the live stems of *Phoradendron flavescens.* Neither one, therefore, can properly be given a common name linked with that of the host plant alone, although so far as has been learned about them, the former is thought to be preëminently *the* American mistletoe weevil. If the writer's opinion holds good with regard to its breeding only during cool or moderately cold weather, it might well be called the "winter mistletoe weevil." Nevertheless, *Pandeleteius cinereus,* at least, stands close in conflict with this appellation.

THE GRAY MISTLETOE WEEVIL,

(*Pandeleteius cinereus* Horn.)

As stated in the foregoing disquisition, the discovery that *Pandeleteius cinereus* Horn also bred in mistletoe stems was brought out in the course of examining a quantity of *Phoradendron flavescens* collected by the writer in company with Mr. W. D. Pierce, near Dallas, Tex., on March 6, 1909. By reason of the fact that we captured the adult on the branches at the time they were obtained, and furthermore swept a stray specimen from a juniper tree standing not far from the same spot, our interest was inductively aroused by suspecting the propensity of the weevil as to its food habits right away. In accord with this inclination, the actual proof of the breeding of the insect in mistletoe eventually fulfilled our expectations. Mr. Pierce is responsible for the determination of the species.

Its larvæ were met with only in the thickened parts of the growth, none of which measured much less than 5 mm. in diameter. At first two subjects were removed alive, but the third made no responsive movement. Their separate trails showed that each individual had started within a node and excavated along through the center of a joint towards its opposite extremity, yet in only one instance did the burrow reach to the next juncture, a distance of one and one-half inches. The rear area of every tunnel was stuffed with frass. Because of the paucity of the grubs, most of the stock was reserved for rearing purposes in order to ascertain if *Pandeleteius cinereus* would really mature from them, and thus establish the identity of the young form for a surety.

On April 6 three dead imagoes were found in the breeding box which contained the material. No parasites can be recorded as attacking this weevil, still all developmental tests were conducted in connection with *Smicraulax tuberculatus.* Since a large proportion of the different foes which bred out from the sprigs under such circumstances agreed with isolated rearings of the kinds preying on the chief invader, very little probability remains that any of them came from another host. At least, no parasitized stage of *Pandeleteius cinereus* has yet been taken.

After being able to recognize the work of this ally, exact signs of it happened to be noticed in an odd joint among the plants that had been brought from Plano, Tex., on February 12. The next record of its occurrence chanced to be the one in which Mr. Pierce reported his finding of two larvæ in stout pieces of mistletoe that were detached from live oak at Mansura, La., on April 13. Judging by the large amount of material which he inspected, and the contrary results of the writer's own examinations preceding him at the same place and in addition at Alexandria, the insect seemed to be somewhat of a rarity in that region. Mr. Pierce has, therefore, supplied the only definite information concerning the existence of any mistletoe weevil in the state of Louisiana. He also secured a number of other interesting insects and various sorts of injuries, all of which will be accounted separately.

From the supply of mistletoe acquired on December 19, 1910, at Dallas, Tex., more examples of the early stage were procured. The main characteristics as noted regarding them will serve to differentiate the larva of *Pandeleteius cinereus* from that of *Smicraulax tuberculatus.* In comparison, the former considerably exceeds the latter in size, and it naturally constructs a larger and longer gallery, always in a plump axis. Its body is entirely pure whitish, even including the head, with the exception of the jaws alone, which are black. As the grub progresses in the formation of its channel it fills the space behind itself with refuse matter.

An attempt to rear one of these forms through artificial introduction into a perfect branch merely demonstrated the possibility of success. On drilling a hole of sufficient play for a short distance lengthwise into the base of an ample section, the tender creature was gently inserted therein with its head foremost. Wet cotton was then wrapped over the opening. The subsequent drying of the wood, however, in spite of its being partly imbedded in moist sand, necessitated almost regular weekly changes of the inmate to fresh growth, but such strict attention could not be carried out continuously.

The ideal way for the thorough study of the development of insects which subsist particularly within the tough portions of such vegetation evidently demands that they be bred or reared on live plants under natural conditions as near as possible. By the selection of suitable offshoots growing on a tree that will permit convenient accessibility for purposes of frequent close observation, the life histories of the weevils or other borers which are prone to adapt themselves thereto could probably be worked out in complete detail. The feasibility of this scheme is expected to depend much upon a skillful insertion of immature specimens into stems, so as to effect their transferences from originally infested branches of different lots. Hope is entertained that the successful replacement of any one after exposing it for inspection may also be accomplished by these means.

Such practices, if dependable, should overcome the paramount difficulties attending the study of developmental stages living within green woody tissues. With the aid of cloth bags to be used for inclosing the sprigs when chosen for breeding experiments, thus affording a necessary protection of the operations between times of examinations and also guarding against the escape of mature colonists, all the advantages of a natural nursery would seem to be placed at the command of an investigator. Although the prospect appealed very strongly, the press of routine duties otherwise prevented the prosecution of the undertaking.

In proposing a vernacular name for *Pandeleteius cinereus*, it may quite fittingly be termed the "gray mistletoe weevil." The species might have other host plants, as it has been taken quite often at random, but so far as known only in territory where mistletoe flourishes.

OTHER COLEOPTERA.

Otidocephalus arizonicus Schf. Det. by W. D. Pierce.

The finding of a lifeless but still fresh adult of this weevil, on April 22, 1911, excited some astonishment, as it was the only outcome of much consequence from a breeding test conducted by the writer with mistletoe branches that had been gathered on March 18 preceding, at Dallas, Tex. Mr. J. D. Mitchell obtained larvæ from twigs which he collected on March 16 at Victoria, Tex. He succeeded in rearing two specimens. One emerged and the other was found dead in a stem on May 28, and then a pupa happened to be secured besides. Three parasites representing the species *Sigalphus curculionis* Fitch matured from the breeding material on April 2. These records are not only new for Texas, but the occurrence of the weevil at Dallas and Victoria shows a remarkable range of the insect which had hitherto been regarded as being peculiar to the arid regions, as in Arizona, where, in fact, the species was discovered by Mr. E. A. Schwarz. (See Bibliography.) As a titular denomination that of the "southwestern mistletoe weevil" may properly be applied to it.

Compsus auricephalus Say.

A single representative weevil was captured by Mr. Mitchell at Victoria, Tex., on March 8, 1909. It was doubtlessly adventitious on mistletoe, since the insect normally breeds in roots of weeds. Record is cited by Mitchell and Pierce. (See Bibliography.)

Sibinia (*Microtychius*) *inermis* Casey. Det. by W. D. Pierce.

Adults were collected as in the preceding case. While Mr. Mitchell took several individuals of this weevil on *Phoradendron flavescens,* he could not detect any signs of their breeding thereon. All were probably incidental visitors.

Smicronyx spurcus? Casey.

One weevil simply marked "Mistletoe," the parts being recalled as dead stems, was submitted by J. D. Mitchell, of Victoria, Tex., under date of March 16, 1911. It answered closely to the description of *Smicronyx spurcus* by Casey.

Anthonomus ochreopilosus Dietz, var. Det. by W. D. Pierce.

Two examples were found on mistletoe by J. D. Mitchell, at Victoria, Tex., during January 16-19, 1911. They were considered to be hibernating weevils.

Brachytarsus limbatus Say.

Mr. Mitchell sent one adult weevil which he recorded as having bred out April 2, 1911, from a joint of dead mistletoe acquired on February 7 preceding, at Victoria, Tex. The maturing of this specimen has made possible the fitness of the same specific designation for an anthribid pupa that he obtained in a similar manner on February 25 succeeding. Attached to the latter form was a well-advanced larva of a hymenopterous parasite.

Thysanoes sp. Det. by A. D. Hopkins.

In the course of inspecting mistletoe at Natchez, Miss., on May 26, 1909, the writer's attention was drawn to a few pinhole openings in some plump, green branches. On cutting into the injured places a tiny ipid beetle chanced to be exposed within a clean, tight-fitting cell just beneath the bark, but unfortunately the specimen was damaged by the thrust of the knife blade. Again, on June 2, other shoots were observed to be rather thickly riddled with similar perforations. Furthermore, the remains of like imagoes were extracted from separate grooves extending longitudinally into the wood from the initial chamber. In every instance, however, these penetrations formed only a single passage and contained no more than one denizen if not being entirely vacant. The positions of the subjects within them denoted that during life each individual had burrowed inward until it died. Their bodies had already become permeated with the resinouslike substance produced by the plant. Those sections which had sustained the attacks varied in thickness from three-eighths of an inch to fully an inch, the largest units being most severely bored of all. After examining such mounts of the insect as could be furnished, none being exactly perfect, Dr. A. D. Hopkins assigned them to the genus *Thysanoes.*

Three additional members that also belonged in this group, according to the same authority, were associated with the relative as cited in the next record. These adults emerged on March 16 and April 2, 1911, but, as noted, all came from defunct wood.

Stephanoderes sp. Det. by A. D. Hopkins.

Another species of Ipidæ was involved in the outcome of the breeding tests with blighted mistletoe that Mr. J. D. Mitchell conducted at Victoria, Tex. It was represented by a single individual, which Doctor Hopkins determined as above. With regard to the date of its appearance, the one as given in the preceding entry must be applied wherewith mention is made of three participants referable to *Thysanoes* sp. Both kinds, therefore, issued from the same stock.

In reality the depredations by such beetles were first noticed by the writer in similar material procured near Dallas. This event indicated that the borers aptly sought out the particular growth in northern Texas. See remarks on Liopus crassulus Lec.

Laria (Bruchus) ochraceus Schf.

Mr. J. D. Mitchell got just one specimen on green mistletoe at Victoria, Tex., March 8, 1909. It was obviously adventitious in this connection.

Liopus crassulus Lec. Det. by H. S. Barber.

Several dead branches of *Phoradendron flavescens* collected by the writer on April 7, 1909, from oak tree, *Quercus schneckii*, near Dallas, Tex., were observed to be severely bored in a lengthwise direction. Besides, they exhibited a scattered number of fine shotlike openings on the exterior parts. The different nature of these ravages, as well as the distinct size of the apertures in each case, showed that more than one kind of insect had worked in the stems. Still no pinhole borer could be detected. Some of the joints were penetrated throughout their whole length by the wider tunnels. The latter were thought to have been made by larvæ of a cerambycid beetle. In substantiation of this surmise, adults of *Liopus crassulus* Lec. effected their release from the material on May 4 and 8.

Neoclytus abbreviatus Schf. Det. by E. A. Schwarz.

Larvæ of another cerambycid were found boring in green mistletoe stems by W. D. Pierce at Sabinal, Tex., on June 3, 1910. Adults determined as above appeared later in the summer, thereby completing the breeding test.

Litargus tetraspilotus Lec. Det. by H. S. Barber.

Six examples which answered to the present name were picked off of mistletoe sprigs by J. D. Mitchell on February 8, 1909, at Victoria, Tex. They seemed to be undergoing hibernation at the time.

Cycloneda munda Say.

This ladybird was taken on fresh mistletoe by the writer at Natchez, Miss., on May 24, 1909. Although no more than one specimen came to hand, it must be expected to visit such growth as well as other vegetation.

Acylomus ergoti (Walsh) Casey. Det. by E. A. Schwarz.

The presence of this beetle on mistletoe was first noted on March 8, 1909, at Victoria, Tex. Mr. Mitchell then secured four individuals, but he took several more during January 16 to 19, 1911, in the same locality.

Carcinops conjunctus Say. Det. by E. A. Schwarz.

Answering to this identification, a couple of imagoes were submitted by Mr. Mitchell, who caught them on mistletoe at Victoria, Tex., in his searches during January 16 to 19, 1911. Their occurrence on the growth was believed to have been induced for the purpose of passing the winter.

PROBABLE CLERID LARVA, fide E. A. Schwarz.

In concluding his observations upon a batch of material at Victoria, Tex., on April 2, 1911, Mr. Mitchell detected the larval stage of what seemed to be a predaceous beetle occupying a cavity in a piece of defunct mistletoe. No better recognition than that already conveyed in the designative heading could be accorded to it by a technical study.

LEPIDOPTERA.

Sesia sp., probably new, fide A. Busck.

The discovery of still another interesting borer of *Phoradendron flavescens* was reported by J. D. Mitchell, of Victoria, Tex., under date of March 8, 1909. He then wrote as follows: "In the stem of one big branch of mistletoe I found five pupæ and one larva of a lepidoptera, and several empty pupal cases and cells. The occupants in undergoing their larval stage had eaten out the interior of the stem and killed the branch."

By accident two of the former subjects, together with the latter, were crushed in the handling; nevertheless he succeeded in rearing a couple of moths, which appeared separately on March 22 and 29. These representatives were passed on as cited above.

Owing to the need of extra specimens, especially of the immature forms in perfect condition, for descriptive purposes, this object being prompted by a desire to learn further about the life history of the species, Mr. Mitchell kept on watch for additional material, but not until January 16 to 19, 1911, did he again come upon any growth that proved to be attacked by the insect, and then only a young individual could be procured; yet he saw enough evidence of late work.

On account of the rarity of its kind, the accompanying description of the larva is given, although this example was judged to be no more than half grown. Length of body, extended, 7 mm.; greatest width, 2 mm., but at head, 1.5 mm. General color, pale yellow; head brown, with anterior margin and sutures dusky; tips of mandibles bidenticulated, black. Thoracic legs yellow; base of prolegs and anal claspers ringed with minute black serrulations. Sparsely clothed with pale hairs.

Efforts to rear this single captive met with a mishap which blocked the operations. The writer first placed it in a drilled hole within a joint of fresh mistletoe, after which disposal the orifice was covered with cotton that had been soaked in water. Eleven days later, when next observed, the shoot had dried out and become brittle, even though the basal portion, inclusive of its primary fork, had been set in a saturated bed of sand. On splitting open the part containing the tenant in order to see how it had fared, the creature unfortunately suffered a fatal stab from a splinter. It had, however, made vigorous progress by boring ahead to about the span of its body, having moved in a diagonal course from the center of the axis to one side almost against the bark. These results, notwithstanding their incompleteness, denote that the borer might be successfully reared under proper care through artificial introduction into green stock.

Nepticula sp., fide A. Busck.

A small metallic-colored moth was found clinging to a twig of mistletoe by J. D. Mitchell at Victoria, Tex., on March 8, 1909. It was considered to be a mere straggler. Its classification could only be carried to the genus already adduced.

Thyridopteryx ephemeræformis Steph.

Several bagworms in their cases were attached to sprigs of mistletoe which W. D. Pierce secured at Mansura, La., on April 13, 1909. Also one hanging bag was likewise taken by the writer at Natchez, Miss., on June 2, 1909. No development came from the supply, but the insect doubtlessly belonged to the species aforenamed. It was very likely a wanderer on the growth, as the larva is not known to feed on the plant.

Tacoma feriella Hulst.

On April 22, 1911, while closing up a breeding test with mistletoe at Dallas, Tex., the stock having been obtained just five weeks before in the outskirts of the city, the writer discerned a lepidopterous pupa among the litter. Shortly afterwards, or by May 5, this subject produced a moth which agreed with the identification as applied hereto. A rather brief interval had therefore elapsed between the date of detection and its maturity. The insect might have existed from its start in the larval stage upon some extraneous food on the green growth, if not directly upon the foliage, fruit or bark itself, until it became quiescent. Otherwise it must have strayed from the host tree, *Quercus schneckii*, and then have completed its cycle in confinement with the detached shoots of *Phoradendron flavescens*.

LEPIDOPTEROUS LARVA.

An elongate form whose larval characters delegated it to the order Lepidoptera was abstracted from a section of dead mistletoe by J. D. Mitchell at Victoria, Tex., on February 25, 1911. Being regarded as of no importance, further classification was not attempted.

Supplementary record: The case-bearer as last mentioned in account of the soft scale. *Coccus hesperidum* L., should perhaps be entered in the present list.

LEPIDOPTEROUS EGGS. (Plate I, fig. 1.)

At Mansura, La., on April 13, 1909, Mr. W. D. Pierce got a few eggs on a mistletoe leaf of which a portion had apparently been eaten away. In a group of five of them, four were placed in approximate pairs, leaving one off by itself. Also a row of three additional ova adhered to a stem. All failed to hatch, but they were speculatively supposed to have been laid by a noctuid moth.

HEMIPTERA.

Leptoglossus ashmeadi Heid. Det. verified by same authority.

Different stages of this attractive bug, together with the outer remains of its eggs, occurred on sprigs of *Phoradendron flavescens* which the writer examined at Natchez, Miss., along in the year of 1909. The first specimen came to hand on May 24 and turned out to be a fresh adult. Five nymphs were caught two days later on branches that displayed the eggshells. These young forms were confined with a supply of green shoots, and although only two individuals reached maturity, having passed the last molt, respectively, on May 27 and 30, they accordingly proved beyond question that both had drawn upon the mistletoe for subsistence. They had chosen the stems, however, instead of the leaves, so far as could be seen. Without doubt the others perished because their less advanced development rendered them too feeble to obtain sufficient nourishment on account of the rapid desiccation of the growth.

The tubular shape of the structures that had originally formed the ova, as well as their arrangement in a row, conformed with the features peculiar in such respects to familiarly known cognate species. A total of twenty shells were attached to one twig, while eighteen duplicates appeared on another section of the plant.

Since the insect had not been met with before in any personal adventure, Mr. Otto Heidemann's description of it (Bul. Buf. Soc. Nat. Sci., vol. 9, 1909, pp. 237, 238) was looked up and found to fit the grown subjects. Still the author gave no information concerning the habits. An example was then sent to him, with a brief account of the capture. In acknowledgment he verified the determination. His type came from Florida.

Podisus acutissimus Stal.

Just one adult as identified herewith chanced to be distinguished by the writer while inspecting some freshly cut mistletoe on December 19, 1910, at Dallas, Tex. At the same time a leaf having nine eggshells attached to it also drew attention. On being scanned closely with the aid of a magnifier these structures were judged to appertain to the species in hand. Both incidents conjointly signified that the insect possessed an adaptability to breed and maintain itself on such growth, at least during a scarcity of more alluring vegetation. Moreover, a deposition of ova agreeing with the former objects in external looks was taken in a like manner at Sherman, Tex., on January 10, 1911.

YOUNG FULGORID, fide O. Heidemann.

The subjective recognition as accorded here referred to an eruciform stage of a small homopteran. It was detected on mistletoe by the writer at Dallas, Tex., on April 7, 1909. Whether this individual represented a species that should be charged with the act of ovipositing on leaves as noted in the next record still remains an open question.

PROBABLE HOMOPTEROUS OVIPOSITION. (Plate I, fig. 2.)

Mr. J. D. Mitchell submitted mistletoe leaves picked by himself at Victoria, Tex., during January 16 to 19, 1911, which disclosed a capricious mode of oviposition by some inferior insect. In all probability the culprit belonged in one of the minor groups of the Homoptera. The ova were inserted generally in a chain through minute slits in the epidermis on both faces of the leafy surface, but the upper side revealed a greater number of the rents. Their nature and positions can best be comprehended by turning to the reproduction of a photograph, as already indicated.

Since the eggs failed to hatch, however, nothing more than provisional deductions could be ventured in explanation of their origin. On seeking the opinions of certain specialists, the following conjectures were expressed: Dr. W. D. Hunter inferred that the committals might have been done by a membracid, if not a near relative. Prof. Herbert Osborn concurred with this idea, remarking that he believed a jassid could have been concerned equally as well. The problem is still further complicated by the preceding observation.

APHIDIDÆ.—*Macrosiphum* sp., undescribed, fide C. E. Sanborn.

On October 29, 1908, Mr. F. C. Bishopp happened to locate a small colony of aphids on mistletoe growing upon an Osage orange or bois d'arc tree, near Dallas, Tex. The live specimens were promptly sent to Prof. C. E. Sanborn, then at College Station, Tex., for study. The latter undertook to breed them, but a grass fire spread under the tree that was utilized for the experiment and destroyed all of the lot. He had satisfied himself, however, that these subjects represented an undescribed species as reported above.

In addition the writer took a single alate form on a plant in his first collection at Plano, Tex., on December 12 following. Professor Sanborn also assigned it to the same genus. Besides, a few individuals of a kindred appearance were removed from shoots when gathered in person at Alexandria, La., on February 27, 1909. Their dead condition unfortunately disqualified them for comparative purposes. So far as personally known, the only prior mention of the occurrence of any aphid on such growth is given in the remark by W. H. Ashmead supplementary to Mr. Schwarz's paper. (See Bibliography.)

COCCIDÆ. (Primary considerations.)

By serving as harbors for scale insects the various mistletoes assume a relative position of some economic importance. The appended bibliography includes quite a number of coccid identifications heretofore recorded from different plants of the family Loranthaceæ. The following contributory notes, however, apply solely to the American mistletoe.

Lecanium nigrofasciatum Perg. The terrapin scale. Det. by J. G. Sanders and Theo. Pergande. (Plate II, figs. 1 and 2.)

Among the coccids that have come to notice in the present survey the above vandal proved to be the chief one. It was first directly met with at Plano, Tex., on February 12, 1909, occurring most numerously on stems, but just scatteringly on leaves. The specific determination was kindly furnished by the authorities as just cited, together with a comment reading thus: "This is a very interesting new host-plant record for the species, although it has been previously reported from various points in Texas." Shortly afterwards the former specialist wrote that a second batch of like material had been received at the Bureau of Entomology, Washington, D. C., this accession having come from Richland, Mo.

About the same time the fact was ascertained that Mr. F. C. Bishopp had found scale insects on mistletoe near Dallas, Tex., during October 29, 1908, of which some might have answered to the preceding name. At least, a *Lecanium* sp. was represented, according to the statement of Prof. G. W. Herrick, who had accepted the specimens for diagnosis.

The likelihood that Mr. Bishopp deserved credit for priority of record in connection herewith was strengthened by the writer's own acquisition of examples of what appeared to be the aforesaid insect upon similar growth at Dallas, Tex., on December 19, 1910. Their smaller size in comparison with those of the initial lot was clearly due to prematureness.

At Mansura, La., on April 13, 1909, Mr. W. D. Pierce obtained a branch literally encrusted with old stages. Many of the bodies dropped off, however, before the photographs could be made, as shown in the plate, to which attention is already called. Then on May 24 of the same year, at Natchez, Miss., a very scant colony chanced to be spied in person. From Victoria, Tex., Mr. J. D. Mitchell transmitted a few small infested sprigs collected by himself during January 16 to 19, 1911. The forms, moreover, were sparingly distributed and undersized.

Pseudococcus sp., fide E. R. Sasscer.

Specimens of a mealy bug, as just designated in part, were first detected by the writer in an old larval cell of the weevil *Smicraulax tuberculatus*. This disclosure attended an inspection of stock which was procured at Plano, Tex., on February 12, 1909.

Under date of March 8 next following, Mr. J. D. Mitchell, of Victoria, Tex., sent a hollow stem resulting from the depredations of *Sesia* sp., but which contained eleven immature forms whose structural characters and flocculent vestiture likened them to the precedent subjects in all essentials, debarring size. Again during his reconnoissance of January 16 to 19, 1911, he came across a joint having a similar cavity, that in this instance was packed full with such insects.

In material that was personally collected at Dallas, Tex., on December 19, 1910, a stray adult happened to be found hiding within an emergence hole of the aforementioned species of weevil. Furthermore, a brood of young scurried out from the interior cranny when it was opened.

All of these examples closely resembled a number of individuals that Mr. Sasscer considered to be *Pseudococcus citri* Risso, which had infested green cotton stalks at Plano, Tex., being taken in June and July, 1910. The possibility of their exact identity is to be expected. No other record is known of either mistletoe or cotton as affording a provident resort for any member of the genus.

Aspidiotus camelliæ Sign. Det. by J. G. Sanders.

A number of scales of this description were secured in person at Alexandria, La., on February 27, 1909. They were attached to both stems and leaves. The same kind, however, appeared to be rare on branches, so far as Mr. W. D. Pierce was able to observe during his visit at Mansura, La., on April 13 ensuing.

It has already been listed for California by E. O. Essig and C. F. Baker. (See Bibliography.)

Supplementary record: An infestation on a deadfall, which was also blackened with sooty mold, this material being picked up by the writer beneath a water oak in Tallulah, La., on May 3, 1919, proved to be due to the same species. Mr. E. A. Sasscer identified it.

Coccus hesperidum L. The soft scale. Det. by J. G. Sanders.

The lodgement of this adaptive pest on some sprigs, inclusive of their foliage, was noted by the writer at Alexandria, La., on February 27, 1909.

A previous report concerning it under like circumstances has been given by W. A. Hooker. (See Bibliography.)

Supplementary record: At Baton Rouge, La., on March 30, 1917, a few specimens were personally taken on leaves, being attended by the Argentine ant, *Iridomyrmex humilis* Mayr. Furthermore, on a part of this material small spots of parenchyma had been eaten away by two tiny unrecognized larvæ, each occupying a spine-shaped case.

Ceroplastes cirripediformis Comst. The barnacle scale. Det. by J. G. Sanders.

A twig which exhibited a few typical forms of the present coccid was saved by Mr. W. D. Pierce while stopping at Mansura, La., on April 13, 1909.

The first record of the species in relation to the same host plant has been published by W. A. Hooker. (See Bibliography.)

Supplementary records: In June, 1913, the writer happened to notice an abundant occurrence of the above insect on shoots that had broken loose from a large live oak after it had been cut down on the university campus at Baton Rouge, La.

A fresh branch which had fallen from the top of another oak tree on the same campus was also much infested when seen on March 30, 1914. Mr. E. A. Sasscer verified the determination.

When, on June 13 of the same year, several sprigs which had dropped from like trees during a hard wind of the preceding day were found beset with young stages well distributed over all parts. Some old forms were attached to a thick piece and its forks. Their identification was pronounced correct by Mr. E. A. Sasscer.

Again a heavy infestation was observed on October 27 succeeding, this case being brought to attention on trimmings.

A remark of interest might be added concerning the protection of these trees in the past against the ravages of mistletoe. All were said to have been thoroughly cleaned during January and February of 1909. Men were then employed to climb them and break off the infesting growth, but of late years it has become quite conspicuous again.

Chionaspis sp., fide G. W. Herrick.

The incomplete classification as rendered here pertained to a kind of scale which Mr. F. C. Bishopp got near Dallas, Tex., on October 29, 1908. In reality it was associated with a *Lecanium* sp., probably *L. nigrofasciatum* Perg., of which an account has been given.

HYMENOPTERA OTHER THAN BRED WEEVIL PARASITES.

Owing to the disposition of various ants to nest in odd cavities and mingle with scale insects, a number of different species of their class has been taken from mistletoe plants. The following list has therefore been compiled, together with the available records.

Strumigenys louisianæ Roger.

At Victoria, Tex., on March 8, 1909, Mr. J. D. Mitchell secured a whole colony of this kind of formicid, including the queen, with all other forms down to the helpless larvæ. These individuals occupied a burrow that had first been made and later vacated by *Sesia* sp.

Camponotus fallax (Nyl.), subsp. *discolor* Buck.

In conjunction with the aforementioned seizure another formicine community having a complement of forces was found in a similar recess. The distinctive traits of the grown members referred them to the cognomination as given hereto. Subsequently, on April 7, at Dallas, Tex., the writer intercepted a rambling worker upon a branch. It possessed all the characteristics as before represented in sort.

Cremastogaster lineolata Say.

A few workers which fell into the hands of Mr. J. D. Mitchell while on his scouting trip around Victoria, Tex., during January 16 to 19, 1911, answered to the present appellation.

Solenopsis geminata Fab.

Several examples of this common forager were collected under the same circumstances as in the preceding case.

Prenolepis (*Nylanderia*) *vividula* (Nyl.), subsp. *melanderi* Wh.

One winged male whose taxonomic features linked it with the above particularization was also acquired in the survey as just noted.

Pseudomyrma gracilis (Emery), var. *mexicana* Roger.

Agreeing with this discrimination, a single worker came to notice. Its capture coincided with that of the former specimen.

Pseudomyrma brunnea F. Sm.

A typical worker of this identity was involved like the foregoing relative.

Iridomyrmex humilis Mayr. The Argentine ant.

The only record of this pest in connection with mistletoe relates to its attendance upon the soft scale, *Coccus hesperidum* L., at Baton Rouge, La., on March 30, 1917. See reference to its accommodator.

COMMENT.

Not all of the other hymenopterous insects that claimed attention can justly be regarded as having gained any particular advantage through their association with mistletoe. While a conspectus of the material was necessarily limited by the restrictions which supervened, yet the actual facts may be of some value.

CHALCIDOID, species to be determined.

One green-colored fly of the nature as implied in advance matured from a supply of dead shoots after they had been kept awhile under observation by Mr. J. D. Mitchell at Victoria, Tex. This breeding test was instituted on February 7, 1911, the date of his collection of the stock. The advent of the stranger tended to convey the impression that it was a parasite of *Brachytarsus limbatus* Say, which then infested some of the stems. Mention has heretofore been made of a parasitized pupa in reference to the same weevil.

CHALCIDOID, undetermined species.

Among the specimens which the writer brought from Natchez, Miss., was a lone individual whose status has not yet been established beyond that of its kinship as just denoted. Its interception chanced to be effected on May 24, 1909. It was presumed to have been a vagrant in respect to its lodgement at the time.

PROCTOTRYPID, species awaiting determination.

The solitary adult in this case was resting on a left when found by the writer at Alexandria, La., on February 27, 1909. It belonged in the category as implied beforehand. According to what is known about the species composing this group, most all of them have parasitic habits. The present member, therefore, might have been on the lookout for prey of the same kind that instigated the malformations which are described in the next entry. Such speculation, however, imposes a vague proposition.

PROBABLE HYMENOPTEROUS GALL FORMATION. (Plate III, figs. 1 and 2.)

Mr. W. D. Pierce reserved quite a lot of branches from his pickings at Mansura, La., on April 13, 1909, the fruiting pedicels of which were badly distorted by gall formations. Nearly all of the excrescences were perforated with tiny holes that had obviously permitted the escape of some sort of producer from within. The best conception of what the agent could have been in nature inclined to a hymenopteran of apt proclivity. Since it had ceased operations, no representative could be secured. A slight suspicion, however, was placed upon the forenoted proctotrypid as having been a likely enemy if not otherwise concerned with the same gall maker in the locality, at least, where the inimical wasp happened to be caught. Samples of the growth which most strikingly showed the deformities are depicted by photographs as reproduced in the plate already designated.

In addition, a somewhat similar plight came under observation at San Antonio, Tex., on April 10, 1911. The sprigs in this instance were personally obtained in a thicket of tall mesquite. The ill condition appeared to have been due to a recent blasting of a majority of the buds on the fructificative appendicles. No positive evidence of any insect attack could be distinguished, yet in view of the possibility that such a perpetration had become obscured if really committed, the abortions were reflectively looked upon as having perchance been caused by inflictive stings consequent to the act of an adversary in depositing its eggs. Owing to the fact that the latter defects conformed in many ways with certain features of the precedent incitement, this likeness on their part was strongly suggestive of an incipient visitation by a provoker possessing a congenerous if not a specific relationship to the one in the prior affair.

COCOONS OF *Apanteles* sp., fide H. L. Viereck.

On sorting over a batch of material that had just been gathered at Dallas, Tex., the date being December 19, 1910, a cluster of small, brownish cocoons attracted the eye of the writer. These objects were attached to a stem in a crosswise position, being arranged side by side in an even row, with the exception that one of the number happened to be elevated above the others at about midway in the chain. All of them proved to be empty, and only two out of the aggregate of twelve cases retained a terminal cap. Their origin was ascribed to parasitic larvæ of the above attribution.

COCOONS OF *Microplitis* sp., fide H. L. Viereck.

While on his quest during January 16-19, 1911, Mr. J. D. Mitchell of Victoria, Tex., procured a couple of leaves, each of which had a miniature cocoon adhering to it. Neither of these envelopes was tenanted at the time, but the before-named expert who examined them arrived at the decision as aforestated respecting their construction.

ORTHOPTERA.

Œcanthus sp., and depositations of eggs.

In the assortment of material which Mr. W. D. Pierce acquired at Mansura, La., on April 13, 1909, he included a few stems containing the eggs of a tree cricket. The structural aspects of the ova and the manner in which the latter had been inserted along the axis of a shoot afforded unmistakable evidence inculpating such an insect. Moreover, a newly hatched eruca that embodied the distinctive characters of the forecited genus chanced to be detected at the next inspection which was effectuated immediately upon the delivery of the stock in Dallas, Tex. This creature and probably others corresponding to it had doubtlessly emerged in transit. Still the lack of further developments occasioned some disappointment.

EVIDENCE OF OVIPOSITION BY *Stagmomantis carolina* L.

The implication of this mantis happened to be noted coincidently with that of the former orthopteran. Its involvement was manifested in the shape of a mass of eggs which typically appertained to the species. The ova, however, failed to hatch.

MINOR INSECTS.

OCCURRENCE OF A PSOCID WITH AN INIMICAL MITE.

The greater share of the minor insects that were found on mistletoe belonged by right to the family Psocidæ. A perplexing instance of such an attraction by one of their kind happened to be taken into account by the writer at Alexandria, La., on February 27, 1909. So far as could be seen, no more than two leaves were affected by the occurrence. Attention was drawn to them by reason of their blotchy look. At first sight the blemishes were thought to be small dabs of a whitish substance, but under ample magnification through a lens they proved to be clusters of minute spherical bodies constituting a total of thirty-one perfect eggs and twelve punctured shells of like deposition. These objects were so jumbled together in clusters that they reflected the utmost disorder and irregularity in the manner of their disposal.

The effects of despoilment were manifested in a singular way. All of the pilferages revealed the same phases of violence, the cause of which, on being considered deeply, resolved itself into an intricate affair. The distinguishing mark by which the defective samples were singled out consisted of a barely visible fracture upon one side of each of them. Only by a very thorough scrutiny could these faults be discerned. Since the clefts seemed to be sunken within the surface, thereby leaving dim indentations in their places, the best definition of them conduced to show that every breach had been produced by a forceful trust from without.

These observations, furthermore, brought to notice the presence of a few prowlers in the form of a mite which lurked beneath their scanty networks of extremely fine webs. The latter had been spun upon some of the ovulated clumps as well as along the edges of them. On noting the savage guise of the agressor, it was immediately blamed for the mischief that had been done. In fact, the rapacious nature of this acarid was conclusively evinced by the similar character of the subsequent raids which attended its multiplication in confinement with the material. Even under these circumstances, several weakling psocids hatched out on March 13, but being menaced by the foe, not the least surprise was excited by their untimely deaths within the next six days.

For additional remarks concerning the raider, see under citation of *Monieziella longipes?* Bks. in list of Acarina.

Pterodela pedicularis L.

At Dallas, Tex., along in April, 1911, while closing up the breeding tests with three local collections of stock that had been obtained at weekly intervals during the preceding month, the writer came upon the above species of Psocidæ. This insect had bred abundantly on the dry, musty branches and leaves.

Cœcilius sp., probably not described, fide N. Banks.

A single specimen as referred to here chanced to be collected in person at Natchez, Miss., on May 24, 1909.

Peripsocus sp., near *permadidus* Walsh, fide N. Banks.

Just one example of this characterization was secured by Mr. J. D. Mitchell at Victoria, Tex., on March 8, 1909.

Troctes divinatoria Müll.

Numbers of this wingless corrodentian occupied an empty cell of the weevil *Smicraulax tuberculatus* Pierce, in material that the writer gathered on December 19, 1910, at Dallas, Tex. Another colony was located at the same time infesting a dead, riddled stem.

Entomobrya multifasciata Tull. Det. by J. W. Folsom.

This collembolous scavenger happened to be spied among bits of detritus that had been shed by the branches which Mr. W. D. Pierce brought from Mansura, La., under date of April 13, 1909. Only a few individuals, however, could be detected.

Entomobrya sp., exact identity not recognized, fide J. W. Folsom.

Two frail nondescripts which closely resembled the foregoing representatives fell into the hands of the writer at Natchez, Miss., on May 25, 1909. After accepting them for study, Doctor Folsom stated that he could not then decide upon their specific identification, but first desire some European forms for comparison.

ACARINA.

Monieziella Longipes? Bks. Det. by N. Banks.

This ravager was taken with the psocid eggs as mentioned heretofore under Minor Insects. Its brownish, hard-crusted appearance plainly betokened a fierce disposition at the outset, while its behavior gave assurance that it really did possess a greedy nature. It thrived well in confinement, evidently feeding upon the ova by extracting their contents and later killing the young insects which issued from such of the former as had escaped harm. Even at the last, it seemed to derive subsistence for a few days from the dead bodies themselves. Although the infested leaves became coated with mold, its activities were not hindered in the least.

The above specialist reported his determination of the specimens as follows: "The mite is one of the tyroglyphids, of the genus *Monieziella,* perhaps *M. longipes* Bks. All the species of the genus are predaceous."

Oripoda elongata Bks. Det. by N. Banks.

Several individuals as assigned here inhabited some of the old abandoned cells of the weevil *Smicraulax tuberculatus* Pierce, belonging in an accession of stock that the writer selected at Natchez, Miss., on May 24, 1909. According to the authority as before named, this acarid feeds on decaying vegetable matter.

Gamasus sp., immature, fide N. Banks.

Examples which could only be classified this far were secured at the same time under like conditions as have been noted in the foregoing record. Mr. Banks expressed his opinion that such forms probably subsist by plunderage.

Liacarus sp., fide N. Banks.

Only a couple of specimens of this sort chanced to be perceived on the exuvial casts of the weevil *Smicraulax tuberculatus* Pierce, which remained inside of the original cavity within one of the branches that the writer got on April 7, 1909, at Dallas, Tex. Mr. Banks stated that they represented "a species of *Liacarus,* one of the oribatid mites, a scavenger, and not parasitic. It had doubtlessly fed on decaying matter in the cell. Various kinds of mites are liable to be found in such places and have no relation to the insect making the hole."

Another individual that might have been an identical form happened to be spied in a similar mine at Sherman, Tex., on January 10, 1911, but as it was inadvertently lost, nothing could be learned about its status.

Oribatula n. sp., fide N. Banks.

At Sabinal, Tex., on June 3, 1910, Mr. W. D. Pierce came upon a mass of mites which had established themselves in a cerambycid burrow. In fact, this space was almost crammed full with the colony. Although the members were readily referred to the genus as just cited, their peculiar distinctions specifically set them off as being new to science. Later developments proved that the originator of the chamber was *Neoclytus abbreviatus* Schf., the record of which has previously been given.

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BAKER, C. F., and ESSIG, E. O. *1912.*—Host index to California Coccidæ. (Cal. St. Com. Hort., Monthly Bulletin, 1, No. 10, Sept., pp. 740-763.)

Cites *Phoradendron flavescens* (mistletoe) as host of *Aspidiotus camelliæ,* U. S. Dept. Agrc.; *Aspidiotus hederæ;* and *Saissetia oleæ,* U. S. Dept., Agrc., p. 755.

[This paper is a duplication of a former one. See Essig, E. O., and Baker, C. F., 1909.]

COCKERELL, T. D. A. *1892.*—List of Coccidæ observed in Jamaica. (Ins. Life, 4, Nos. 9 and 10, June, pp. 333-334.)

Cites "*Lecanium* (?) *dendrophthoræ* Ckll. MS. On *Dendrpphthora.* . . . I keep it provisionally as a *Lecanium,* but quite expect it is (as I supposed) a *Pulvinaria* or *Lichtensia,*" p. 333.

—— *1893.*—Notes on *Lecanium,* with a list of the West Indian species. (Trans. Amer. Ent. Soc., 20, April, pp. 49-56.)

Lecanium hemisphæricum Targioni-Tozzetti reported as occurring on *Dendrophthora cupressoides* Eichler, in Jamaica, p. 55. The insect is now known as *Saissetia hemisphærica,* the hemisphærical scale.

—— *1893.*—Two new species of *Pulvinaria* from Jamaica. Trans. Ent. Soc. London, for year 1893, June, pp. 159-163.)

Describes *Pulvinaria dendrophthoræ,* n. sp., on *Dendrophthora cupressoides,* p. 162.

—— *1894.*—Two new Coccidæ from the arid region of North America. (Ann. Mag. Nat. Hist., (6), xiv, July, pp. 12-15.)

Describes *Lecanium phoradendri,* n. sp., on *Phoradendron* from Arizona, p. 14. The host species has since been referred to by the author as *Phoradendron macrophyllum* Engelm. (See "The lower and middle Sonoran zones in Arizona and New Mexico," Amer. Nat., 34, April, 1900, p. 293.)

Gives the following note, p. 15: "This makes the third coccid believed to be found only on Loranthaceæ; the others are *Diaspis visci* Schr. on *Viscum,* in Europe, and *Pulvinaria dendrophthoræ* Ckll. on *Dendrophthora,* in Jamaica."

—— *1895.*—Coccidæ or scale insects, VII. (Bul. Bot. Dep. Jam., II, May, pp. 100-102.)

Cites *Pulvinaria dendrophthoræ* Ckll. on *Dendrophthora cupressoides,* and states that the scale may be a variety of *P. cupaniæ* Ckll., p. 102.

—— *1897.*—The food plants of scale insects (Coccidæ). (Proc. U. S. Nat. Mus., 19, pp. 725-785.)

The following summary of records, with references, is given, p. 764: "For a note on the coccids peculiar to Loranthaceæ, see Cockerell.[2] *Diaspis visci* Schrank is from *Viscum album.* From *Phoradendron* comes *Lecanium phoradendri* Cockerell. Mr. W. G. Johnson has sent me some *Phoradendron flavescens* from Palo Alto, Cal., on which are *Lecanium oleæ,* Bernard, and a form of *Aspidiotus rapax,* Comstock. On *Dendrophthopa cupressoides,* Eichler, in Jamaica, have been found *Pulvinaria dendrophthoræ,* Cockerell, and *Lecanium hemisphæricum,* Targioni-Tozzetti."[3]

—— *1898.*—New Coccidæ from Mexico. (Ann. Mag. Nat. Hist., (7), i, June, pp. 426-440.)

Gives descriptions of the following new species of scales on mistletoe: *Porococcus pergandei,* host from lime tree, *Cuantla,* p. 427; *Porococcus tinctorius,* host from oak, *Ameca,* p. 427; and *Diaspis phoradendri,* doubtless on *Phoradendron,* Cuantla, p. 437. Regarding the last species the author has stated in letter: "No doubt a native insect and nothing particular to do with *D. visci.*"

—— *1902.*—A contribution to the knowledge of the Coccidæ. (Ann. Mag. Nat. Hist., (7), ix, June, pp. 450-456.)

Generically revises *Lecanium phoradendri* Ckll. to *Mesolecanium phoradendri,* p. 452.

—— *1902.*—A catalogue of the Coccidæ of South America. (Rev. Chil. Hist. Nat., vi.)

Includes description of *Lecanium insolens* King reported on *Philodendron* from Brazil, p. 255. Refers to the following species of scale insects known to occur on mistletoe, giving citation of original descriptions and native habitats: *Diaspis phoradendri* Ckll.; *Diaspis visci* (Schr.); *Porococcus tinctorius* Ckll.; *Porococcus pergandei* Ckll.; and *Mesolecanium phoradendri* (Ckll.).

—— *1912.*—*Pseudococcus phoradendri* Cockerell, new species. See Wheeler, W. M., 1912. Notes on a mistletoe ant. Description, p. 133 and 134. [This species may possibly be same as the one mentioned in the present paper.]

Comstock, J. H. *1883.*—See Fernald, Mrs. M. E.

Essig, E. O., and Baker, C. F. *1909.*—A host index to Californian Coccidæ. (Pomona Jr. Ent., 1, No. 2, June, pp. 53-70.)

Cites as follows, on p. 64: "*Phoradendron flavescens* (mistletoe). *Aspidiotus camelliæ,* U. S. Dept. Agrc.; *Aspidiotus hederæ; Saissetia oleæ,* U. S. Dept. Agrc."

—— *1912.*—See Baker, C. F.

Fernald, Mrs. M. E. *1903.*—A catalogue of the Coccidæ of the world. (Bul. 88, Hatch Exp. Sta. Mass. Agr. Coll.)

Cites the following species from mistletoe: *Porococcus pergandei* Ckll., p. 70 (see Cockerell, T. D. A.). *Porococcus tinctorius* Ckll., p. 70 (see Cockerell, T. D. A.).

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[2] Ann. Mag. Nat. Hist., 1894, p. 15.

[3] Cockerell, Trans. Ent. Soc. Lond., 1893, p. 162; Trans. Amer. Ent. Soc., 1893, p. 55.

Cites on p. 131: *Pulvinaria dendrophthoræ* (Ckll.). *Lecanium dendrophthoræ* Ckll., Ins. Life, iv. p. 333 (1892). *Pulvinaria dendrophthoræ* Ckll, Tr. Ent. Soc. Lond., p. 162 (1893). *Pulvinaria dendrophthoræ* Ckll., Bull. Bot. Dep. Jam., ii, p. 102 (1895). Habitat: Jamaica, on *Dendrophthora cupressoides.*

Cites on p. 176: *Mesolecanium phoradendri* (Ckll.). *Lecanium phoradendri* Ckll., Ann. Mag. Nat. Hist., (6), xiv, p. 13 (1894). *Mesolecanium phoradendri* Ckll., Ann. Mag. Nat. Hist., (7), ix, p. 452 (1902). Habitat: Arizona, on *Phoradendron.*

Cites on p. 232: *Diaspis phoradendri* Ckll. (See Cockerell, T. D. A.)

Cites on p. 233: *Diaspis visci* (Schr.). *Coccus visci* Schr., Enum. Ins. Austr., pp. 296, 588 (1781). *Aspidiotus visci* Loew, Verh. z. b. Ges., Wien. xii, p. 110 (1862). *Diaspis visci* Loew, Verh. z. b. Ges., Wien. xxii, p. 273 (1872). *Aspidiotus visci* Kalt., Die Pflanz., pp. 293, 785 (1874). *Diaspis visci* Kalt., Die Pflanz., p. 785 (1874). *Aspidiotus visci* Sign., Ann. Soc. Ent. Fr., (5), vi, p. 603 (1876). *Diaspis visci* Comst., 2nd Rep. Dep. Ent. Corn. Univ., p. 96 (1883). Habitat.—Europe. On mistletoe (*Viscum album*).

Fulmek, L. *1910.*—[*Gossyparia spuria* on *Viscum album.*] (Centbl. Bakt. [etc.] 2, Abt. 25, Nos. 1-4, pp. 106-108, figs. 3).

"The author reports the finding of the European elm scale on the mistletoe (*V. album*) growing in the vicinity of Durnstein, Austria." (From Exp. Sta. Rec., U. S. D. A., 23, No. 7.) The species *Gossyparia spuria* should be accredited to Modeer.

Hooker, W. A. *1908.*—[Coccidæ on mistletoe in Texas.] (Proc. Ent. Soc. Wash., 10, p. 10.)

Reports three species of scale on *Phoradendron flavescens* from mesquite, collected at Eagle Pass, Tex., October, 1907: *Ceroplastes cistudiformis* Towns. & Ckll., a new record for host plant; *Coccus hesperidum* L.; and *Aulacaspis* sp.

Kaltenbach, J. H. *1874.*—See Fernald, Mrs. M. E.

King, G. B. *1902.*—See Cockerell, T. D. A. A catalog of the Coccidæ of South America.

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MacGillivray, A. D. *1912.*—The Washington meeting of the Entomological Society of America. (Psyche, 19, Feb., p. 22 and 23.) Gives announcement of the present paper, being presented by A. Rutherford, p. 22.

—— *1912.*—Proceedings of the Washington meeting. (An. Ent. Soc. Amer., 5, March, pp. 76-88.) Gives short abstract of the present paper, being presented by A. Rutherford, p. 76.

Mitchell, J. D., and Pierce, W. D. *1911.*—The weevils of Victoria county, Texas. (Proc. Ent. Soc. Wash., 13, No. 1, pp. 45-62.)

Cites *Compsus auricephalus* Say from *Phoradendron flavescens,* p. 48.

—— *1912.*—The ants of Victoria county, Texas. (Proc. Ent. Soc. Wash., 14, pp. 67-76.)

Cites the following species collected on mistletoe, all of which are reported in the present paper: *Pseudomyrma gracilis mexicana, Pseudomyrma brunnea, Solenopsis geminata, Cremastogaster lineolata, Strumigenys louisianæ, Prenolepis (Nylanderia) vividula melanderi,* and *Camponotus fallax discolor.*

Pierce, W. D., assisted by R. A. Cushman and C. E. Hood, under the direction of W. D. Hunter. *1912.*—The insect enemies of the cotton boll weevil. (U. S. Dept. Agr., Bu. Ent., Bul. 100, issued April 3.)

Gives the following citations: *Eurytoma tylodermatis* and *Cerambycobius cyaniceps,* p. 50; *Catolaccus hunteri,* p. 51; and *Microbracon mellitor,* p. 58, all as parasites of *Smicraulax tuberculatus* in mistletoe stems. States that *Smicraulax tuberculatus* is known to breed in stems of *Phoradendron flavescens* in Texas, Louisiana and Mississippi, being parasitized by the above-mentioned species, p. 76, and it is also cited in list of host plants, p. 80.

Pierce, W. D. *1913.*—Miscellaneous contributions to the knowledge of the weevils of the families Attelabidæ and Brachyrhinidæ. (Proc. U. S. Nat. Mus., v. 45, May 23, pp. 365-426.)

Cites *Pandeleteius cinereus* Horn, taken at Dallas, Tex., March 6, 1909, breeding in twigs of *Phoradendron flavescens* on *Hicoria alba,* Pierce and Tucker, p. 404. Instead of *Hicoria alba,* the specific name of the host tree should be *Quercus schneckii.*

SCHAEFFER, CHAS. *1906.*—New Rhynchophora. (Can. Ent., 38, October, pp. 339-344.)

Cites *Cryptorhynchus lacteicollis* Champ.: "Taken by beating mistletoe growing on walnut," in Arizona, p. 344. (Also, see Schwarz, E. A.; footnote.)

SCHRANK, FRANZ VON PAULA. *1781.*—Enumeratio insectorum Austriæ indigenorum. (See Fernald, Mrs. M. E.)

SCHWARZ, E. A. *1901.*—On the insect fauna of the mistletoe. (Proc. Ent. Soc. Wash., 4, pp. 392-394.)

Records, on authority of Kaltenbach, four species from *Viscum album* of Europe: *Psylla visci* Curt. (*exophila* Frfd.), *Aspidiotus visci* Frfd., and two cerambycids of the genus *Pogonocherus.* Reports from *Phoradendron* in the United States: *Lecanium phoradendri* Ckll., and an undescribed psyllid from California, collected on *Phoradendron macrophyllum.* A coccinellid, *Cephaloscymnus occidentalis* Horn, an enemy of the scale *Lecanium phoradendri,* on *P. macrophyllum,* was rare in Arizona. Curculionid larvæ boring in branches proved to be an undescribed *Otidocephalus,** its deserted galleries being occupied by ants, *Cremastogaster* sp., which attended the scales. The dead and dying branches resulting from the attacks of the weevils were bored by scolytid beetles belonging near the genus *Stephanoderus.* A bostrychid borer bred out as an undescribed species of *Amphicerus.* Lycænid larvæ which fed on leaves bred out *Thecla halesus.*

In remarks, Mr. W. M. Ashmead stated that he had seen a scale insect and an aphid on mistletoe at Jacksonville, Fla., but he had not worked them up.

SIGNORET, VICTOR. *1876.*—See Fernald, Mrs. M. E.

WHEELER, W. M. *1912.* Notes on a mistletoe ant. (Jr. N. Y. Ent. Soc., 20, June, pp. 130-134.)

Reports occurrence of ant colonies of the species *Cremastogaster arizonensis* Wh. in burrowed stems of *Phoradendron flavescens* var. *villosum* growing on live oaks, *Quercus emoryi,* in the Huachuca mountains, Arizona. A species of coccid described by Prof. T. D. A. Cockerell as *Pseudococcus phoradendri,* n. sp., was invariably found attended by the ants in their nesting cavities. Author refers to observations made by Mr. E. A. Schwarz in his paper, "On the insect fauna of the mistletoe." (Proc. Ent. Soc. Wash., v. 4, 1901, pp. 392-394.) The following species mentioned by Mr. Schwarz are cited: *Lecanium phoradendri, Cephaloscymnus occidentalis,* an undescribed species of *Otidocephalus* which caused the burrows, *Cremastogaster* sp., a species belonging near *Stephanoderus, Amphicerus* sp., and *Thecla halesus.* The ants (*Cremastogaster*) and the borer (*Otidocephalus*) as referred to in the latter respects are believed to be identical in each of the two cases.

Author describes female and male forms of *Cremastogaster arizonensis* and gives Professor Cockerell's description of *Pseudococcus phoradendri.*

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* Since described by Mr. Chas. Schaeffer as *Otidocephalus arizonicus,* but without mention of its habits. (New Rhynchophora, II. Jr. N. Y. Ent. Soc., 15, June, 1907, p. 76.)

EXPLANATION OF PLATES.

PLATE I.

FIG. 1. Probable lepidopterous eggs on mistletoe leaf and stem, enlarged six diameters.

FIG. 2. Leaf of mistletoe, showing scars of oviposition by supposed homopterous insect, enlarged four diameters.

PLATE II.

FIG. 1. Mistletoe stems infested with the terrapin scale, *Lecanium nigrofasciatum* Perg., natural size.

FIG. 2. Section of former enlarged six diameters.

PLATE III.

FIG. 1. Gall formations on fruiting pedicels of mistletoe, natural size.

FIG. 2. Bunch of galls enlarged six diameters, showing emergence holes of supposed hymenopterous producer.

All from original photographs by the author, except that acknowledgment is due Mr. G. N. Wolcott for assistance in making the original of figure 2, plate I.

TRANS. KANSAS ACAD. SCI., VOL. XXX. PLATE I.

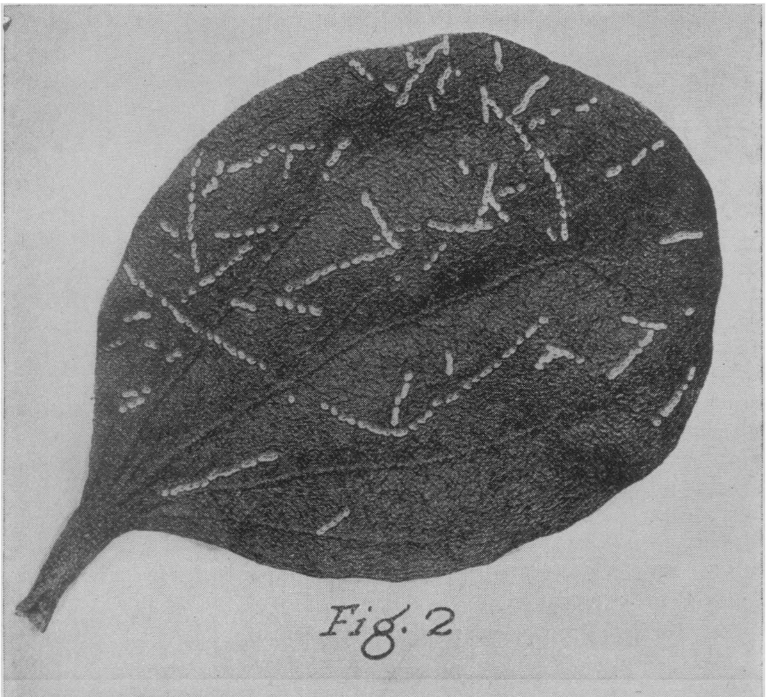


Fig. 2

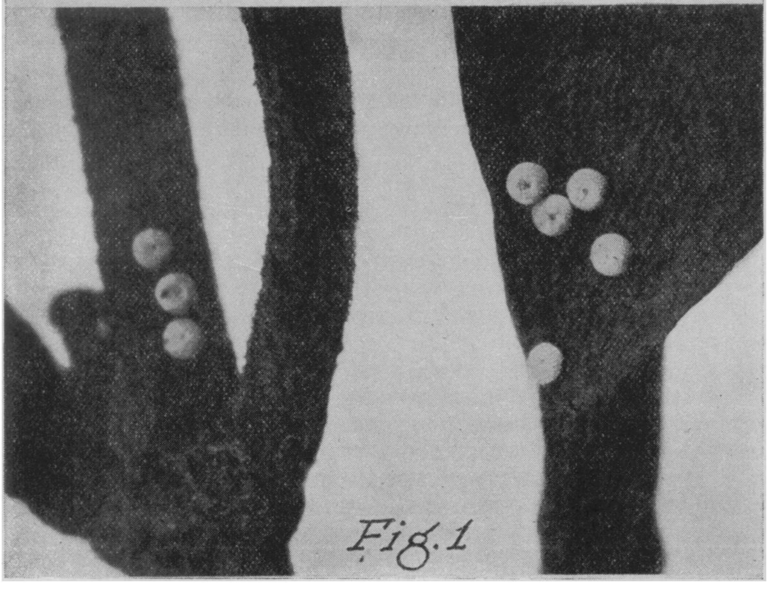
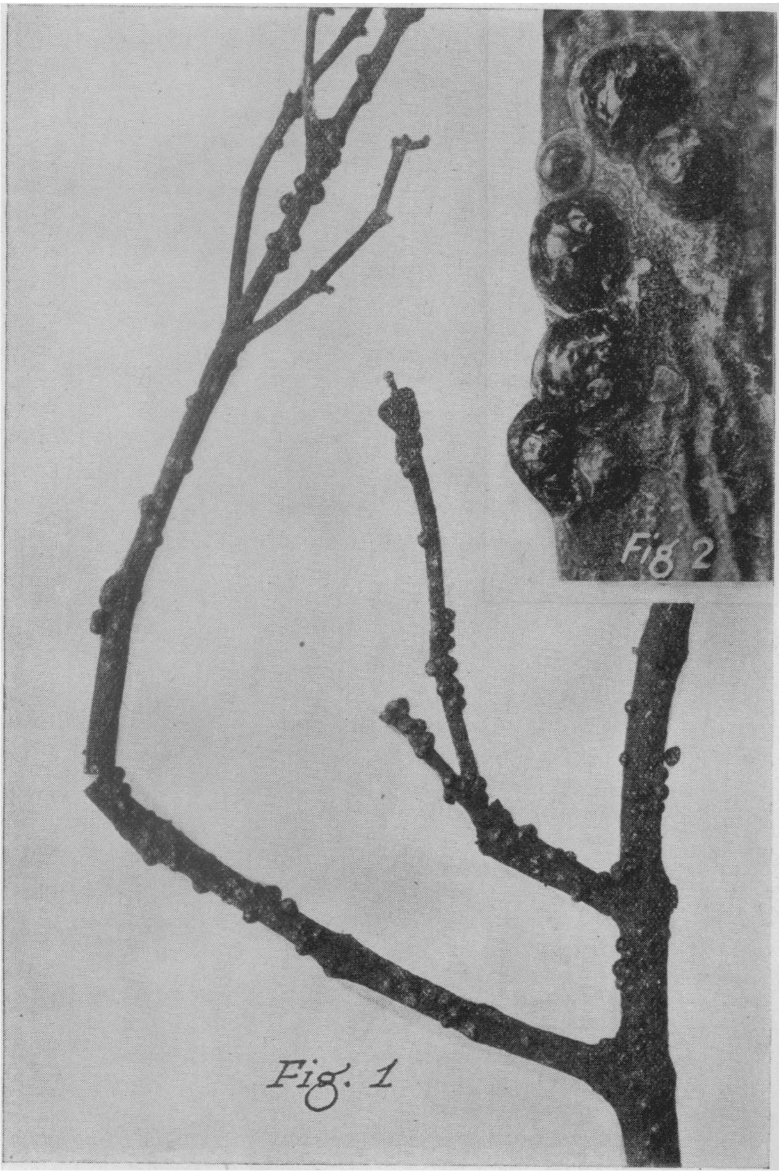


Fig. 1

PLATE II.



TRANS. KANSAS ACAD. SCI., VOL. XXX. PLATE III.